

# Subgradient

---

Nipun Batra

July 20, 2025

IIT Gandhinagar

- Generalises gradient to convex but non-differentiable problems

# Subgradient

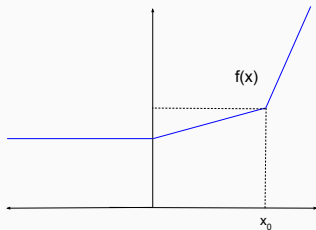
- Generalises gradient to convex but non-differentiable problems
- Examples:

# Subgradient

- Generalises gradient to convex but non-differentiable problems
- Examples:
  - $f(x) = |x|$

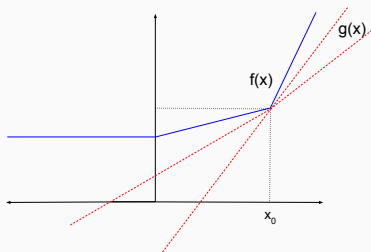
# Task at hand

- TASK: find derivative of  $f(x)$  at  $x = x_0$



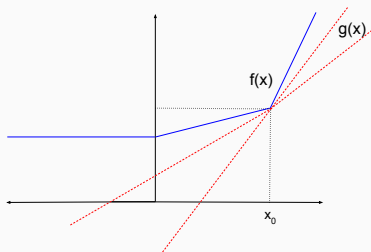
# Solution

- Construct a differentiable  $g(x)$



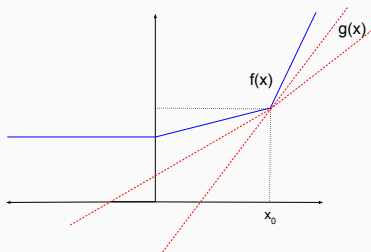
# Solution

- Construct a differentiable  $g(x)$ 
  - Intersecting  $f(x)$  at  $x = x_0$



# Solution

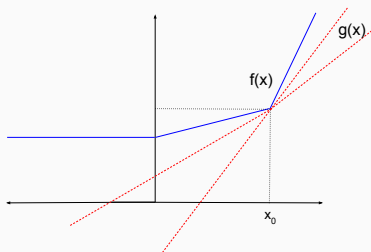
- Construct a differentiable  $g(x)$ 
  - Intersecting  $f(x)$  at  $x = x_0$
  - Below or on  $f(x)$  for all  $x$





# Solution

- Compute slope of  $g(x)$  at  $x = x_0$



## Another Example: $f(x) = |x|$

- Subgradient of  $f(x)$  belongs to  $[-1, 1]$

